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AN EXPERIMENTAL INVESTIGATION ON GLASS /CARBON FIBRE HYBRID COMPOSITE MATERIAL

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ABSTRACT

The primary target of this work is to study the three samples of glass fibre /carbon fibre strengthened with three distinctive proportion layers with epoxy pitch. The soundness of samples tested by using non-destructive testing method such as vibration analysis and mechanical testing methods such as Tensile test, Impact test, and hardness survey. The ultimate aim of this study to predict the quality of among these three-composite sandwiches.

KEYWORDS: Composite, Glass Fibre, Carbon Fibre, Epoxy Resin, Destructive Testing & Vibration Analysis

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Original Article

INTRODUCTION

The blend of at any rate two materials is known as the composite material in which material have one of a kind quality that are absolutely novel in connection to the individual materials included. The material here we utilized is glass fibre/carbon fibre composite materials are the incredible potential for designing material in numerous applications. Half and half polymer composite material offers the planner to get the required properties in a controlled significant degree by the selection of strands and grid. The properties of the material by choosing various types of fibre consolidated in a similar gum grid. In the present examination, the mechanical properties of carbon and glass filaments strengthened epoxy half breed composite were contemplated. This material contains for all intents and purposes no air or gas, is progressively thick. Epoxy sap is added to every material with various rations. Epoxy has a wide extent of uses, including metal coatings, use in equipment/electrical fragments/LEDs, high strain electrical spreads, paint brush creating, fibre-invigorated plastic materials and helper concretes. Epoxy is now and again used as glue[1-3].

Cross breed composite materials are the incredible potential for building material in numerous applications. Cross breed polymer composite material offers the originator to get the required properties in a controlled significant degree by the selection of strands and network [4-6]. The properties are custom-made in the material by choosing various types of fiber fused in a similar tar network. Polymer-network composites (PMCs) have been utilized for an assortment of auxiliary participations for compound plants and planes, since they have remarkable exhibitions, for example, lightweight and great weakness properties [7-11]. Different assembling procedures are utilized for making Glass Fiber/Epoxy composite. In light of complete writing survey of different viewpoints in creating Glass Fiber/epoxy composite material, it is seen that broad work has been done identified with assembling and mechanical portrayal of current material, though restricted investigations did to examinations ductile, shear and flexural quality by shifting volume part of glass fiber and epoxy materials [12-14]. Fiber Reinforced Plastics (FRP) has fundamentally extended their application in aeronautic trade as of late. Preferences

like light weight, minimal effort, straightforward support and prevalent erosion obstruction have been perceived in spite of the fact that the structure of fiber fortified materials are normally not surely known as those for metallic partner [15–17]. Glass and carbon fibre are one of the promising fortifications in polymer lattice composites. In this task, a correlation of mechanical properties and disintegration opposition has been explored for glass and carbon fiber composites. The composites were created by hand lay-up procedure [18-19]. Fiber strengthened polymer (FRP) composite materials are heterogeneous and anisotropic materials that don't display plastic twisting. They have been utilized in a wide scope of contemporary applications especially in space and aeronautics, car, sea and assembling of games hardware. Carbon fiber strengthened polymer (CFRP) and glass fiber fortified polymer (GFRP) composite materials, among other fiber fortified materials, have been progressively supplanting customary materials with their astounding quality and low explicit weight properties[20]. Glass filaments fortified polymer composites have been set up by different assembling innovation and are broadly utilized for different applications. These days, it has been utilized in gadgets, flying and vehicle application and so on.

The main scope of this study to predict the soundness of the Glass/Carbon reinforced fibre using by destructive and non-destructive method. The raw materials (Glass/Carbon fibre) of this study are easily available and it have broad applications in industries side. Glass fiberstrands are having amazing properties like high quality, adaptability, solidness and protection from substance.

MATERIALS AND METHOD

Materials Used

Glass fibre/carbon fibre was used as fundamental fortress material. Composite precedents were produced using hand lay-up system sought after by weight. The samples were tested using by ASTM Standards. Strength test was executed by ASTM D638 standard with a test speed of 2 mm/min. Flexural and Impact tests were performed by respectively ASTM D790 and ASTM D256 and hardness test conducted by using ASTM D 2583. The given materials utilized in this work for made the composite:

- Resin used: Epoxy pitch (Araldite LY556)
- Hardener utilized :HY917
- Specification thickness: Unidirectional (UD) glass fibre/carbon fibre thickness is 2mm
- Specimen plate measurement: All the composite model plates are made in the measurement 210mm*290mm *2mm.

Samples Preparation

The planning of the composite we ascertain the volume part percentage of epoxy resin and number of layers of glass fibre and carbon fibre appeared in Table1. The upper and lower layer is glass fiber and in between them is placed 1,2 and 3 layers of carbon fiber with each layer is binder with epoxy resin. The amount of the epoxy resin used for binding is 350gms. The composite plate is made using hand lay-up method. After fabrication the plate is allowed to dry for 7 days. The composite material shown in Figure1. Later the composite plates are handed over for testing.

Table 1: Composite Samples Details

Material	Glass Fibre (Layers in Number)	Carbon Fiber (Layers in Number)	Epoxy (Weight % in grams)
SAMPLE 1	2	1	350
SAMPLE 2	2	2	350
SAMPLE 3	2	3	350

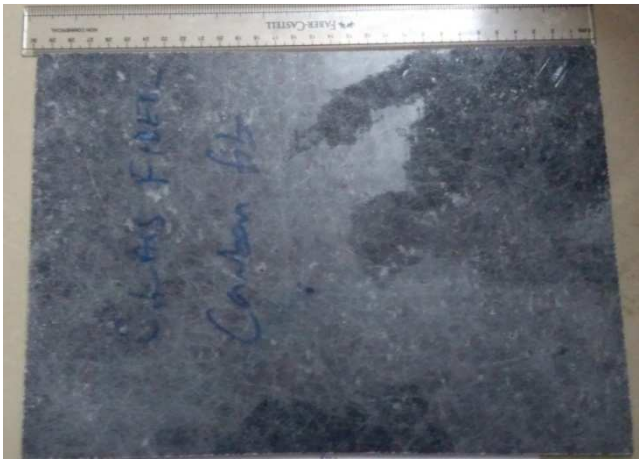

Figure 1: Glass and Carbon Fibre Reinforced Epoxy Composite Sample

Methodology

STEP-1: Fabrication utilizing hand lay-up technique.

STEP-2: Non-destructive testing.

STEP-3: Destructive testing.

STEP-4: Identification of better sample.

STEP-5: Result investigation

STEP-6: Conclusion

Tensile Test

A tensile test generally called to determine the strength of the given samples. This test is most vital and fundamental sorts of mechanical testing. A flexible test applies malleable (pulling) capacity of a material and measures the sample's response to the Load. The tensile strength is conducting room temperature and stated by ASTM D638with a test speed of 2 mm/min.

Impact Test

It this test also determines the strength of the materials using oscillation pendulum load. A method for choosing behaviour of material presented to daze stacking in twisting, strain, or torsion. The test conducted by room temperature and samples prepared by using ASTM D256 standard.

Hardness Measurement

Hardness measurement used for the given composite materials point out the applications. Hardness survey taken of given all the sample in five places and finally get average and listed below. This measurement also conducted under room temperature. The samples preparation and testing procedure was stated by ASTM D 2583.

Flexural Testing

Flexural tests are commonly used to decide the flexural modulus or flexural quality of a Material. A flexure test is more moderate than a pliable test and test outcomes are somewhat unique. The material is laid on a level plane more than two of contact (lower bolster range) and after that a power is connected to the highest point of the material through it is possible that a couple of purposes of contact (upper stacking length) until the example comes up short. This test conducted under the room temperature using ASTM D790 standard.

Vibration Analysis

It is one of the non-destructive testing methods. Samples soundness are determine by in this method and also analysed by adhesion and non-adhesion regions of the samples. The different frequency probe is used in this test. The background this test is uses Piezo electric effect. It is nothing but the electric energy converted to mechanical energy or vice versa.

RESULT AND CONCLUSIONS

The Present investigation has been done on three samples made of with Glass fibre, Carbon fibre and Epoxy was shaped utilizing uniform size. Once fabrication is completed, the samples were under examination of vibration analysis and other mechanical testing methods. The concluding results are following.

Tensile Strength

The strength of the composite material determined by tensile test. The test specimen designed, according ASTM D638 standard and test conducted by under the room temperature From the testing result it shows that the sample 2 is given good strength comparing the other samples (Figure 2). The strength value is 1000N observed in this test.

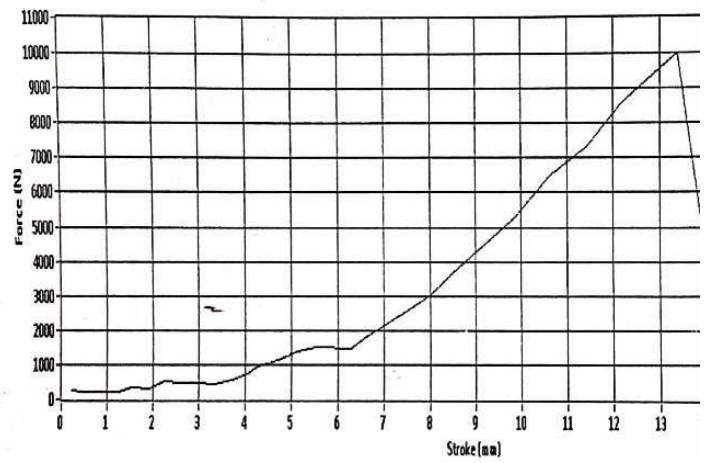

Figure 2: Stress Strain Plot

Impact Testing

Impact test is conducted in room temperature using ASTM D256 standard. Impact strength is observed almost equal in 3 joules in all the three samples.

Hardness Survey

The hardness esteem got from barcol hardness. Hardness esteem pursued concurring ASTM D 2583 standard. The Figure 3 demonstrates the hardness estimation of three examples. Each sample hardness estimated in three diverse places. The result demonstrates that the specimen 3 has the most noteworthy esteem and specimen 1 has the minimum barcol hardness esteem in light of the fact that the reason of kelp content. The example 2 has almost equivalent to the base material value among the three samples. The sample 2 has almost 15 HVN. It is shown in Figure 3.

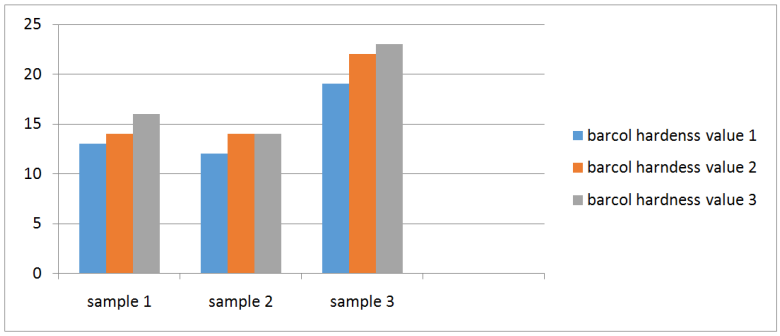

Figure 3: Hardness Test Plot

Flexural Test

Flexural test is conducted in given three samples using ASTM D790. The sample 2 is high strength value comparing to other sample. The maximum flexural load is observed almost 0.44 KN. It is shown in Figure 4.

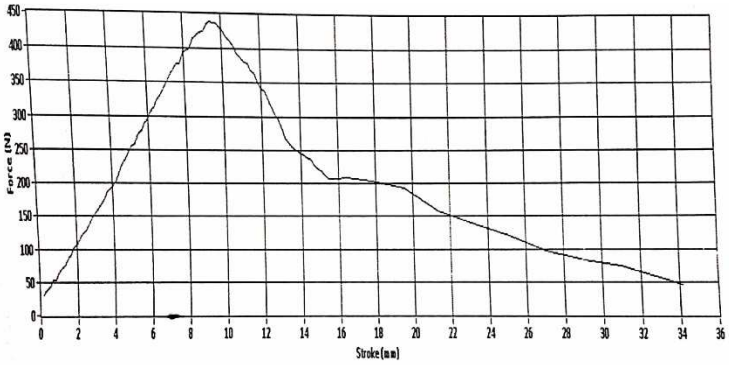

Figure 4: Flexural Test Plot

Vibration Analysis Testing

Presently the quality of the bond or adhesion between glass fibre and carbon fibre investigated by vibration analysis test. This test decided the nature of the joints or authoritative between given materials. The test experienced with a frequencies of 200Hz, 400Hz, and 600Hz. It is indicated is Figure 5, Figure 6 and Figure 7. Because of the recurrence sent through the test the reverberation sign is delivered. This testing technique decided glue and non-cement conduct of composite material utilizing reverberation sign showcase by an examine strategy. By and large, the reverberation sign jump

on the composite material is low, at that point it implies there is great cement conduct between the two material other hand, high reverberation sign jump on the composite material it implies the glue isn't great between the material. In this examination, the sample 2 is get lower reverberation adequacy looking at different examples is seen from this testing strategy.

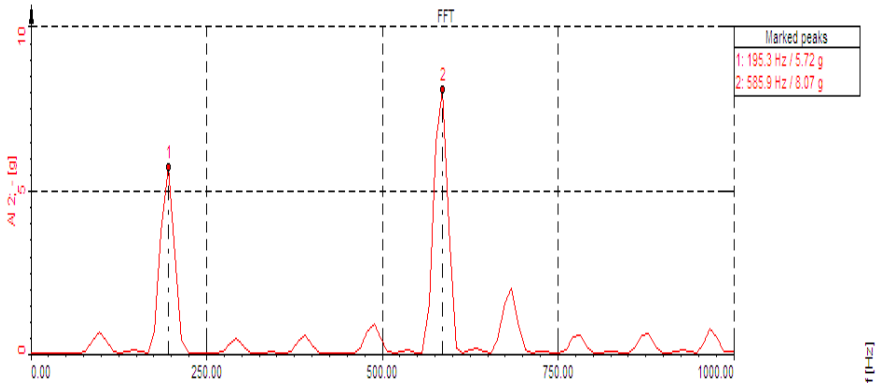

Figure 5: The Plot between Thickness Versus Amplitude in Vibration Analysis Test using Frequency of 200 Hz

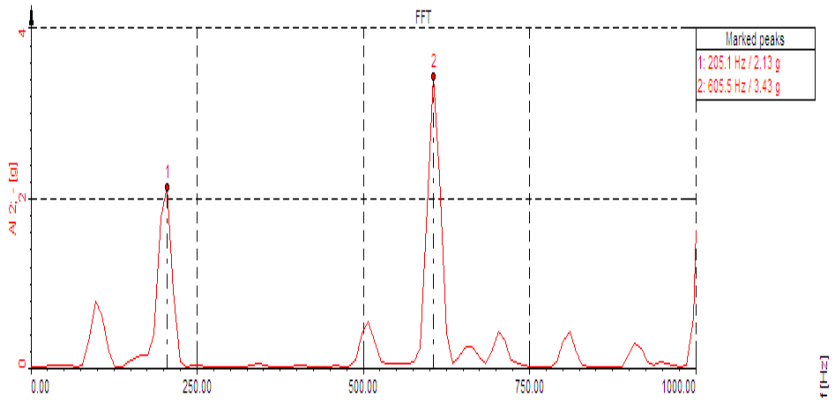

Figure 6: The Plot between Thickness Versus Amplitude in Vibration Analysis Test Using Frequency of 400 Hz

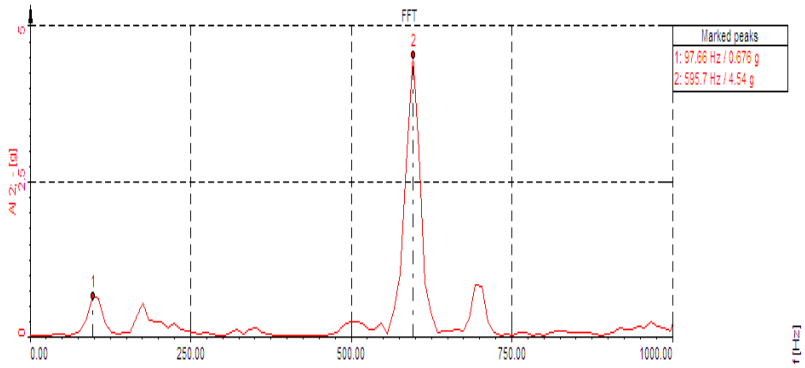

Figure 7: The Plot between Thickness Versus Amplitude in Vibration Analysis Test Using Frequency of 600Hz

CONCLUSIONS

In this investigation, the mechanical properties of three sandwich composite instances of glass fibre/carbon fibre is found and appeared differently in relation to find the better composite model with the good results. The sample 2 has good adhesion property as well as mechanical properties.

Tensile strength of sample 2 has 1000N, Impact strength has almost 3J and Barcol hardness regards for sample 2 has 15HVN and the Flexural strength has 0.44KN.

The sample 2 has then inspected to locate the great glue and less glue locale using vibration examination testing and the result is discussed.

REFERENCES

1. *L. S. Jayakumari, G. Suresh (2015) Evaluation the mechanical properties of E-Glass fiber/carbon fiber fortified interpenetrating polymer systems, Polymeros, vol.25, ISSN: 0104 – 1428.*
2. *T D Jagannatha (2015) Mechanical Properties Of Carbon/Glass Fiber Strengthened Epoxy Half breed Polymer Composites, Vol. 4, ISSN: 2278 – 0149.*
3. *GeetanjaliGuggari (2011) Writing Survey of Fiber Fortified Polymer Composites, International Journal of Advances in Engineering & Technology, ISSN: 2231-1963.*
4. *Chavan (2016) Review on Development of Glass Fiber/Epoxy Composite Material and its Characterizations International Journal of Science, Engineering and Technology Research (IJSETR) Volume 5, ISSN: 2278 – 7798.*
5. *Ramachandran Manickam, (2015) Examination of mechanical properties of glass and carbon fiber fortified polymer material, Volume 10, ISSN 0973-4562.*
6. *Ramesh Kumar Nayak (2019) Assessment of Mechanical Properties of Glass Fiber and Carbon Fiber Strengthened Polymer Composite, Volume 8, ISSN: 2321-5151 (Print).*
7. *D M Nuruzzamann (2016) Exploratory examination on the mechanical properties of glassfibre fortified nylon, IOP Conf. Arrangement: Materials Science and Building 114 012118.*
8. *B. Yogesha (2015) Study on Mechanical Properties of Characteristic - Glass Fiber Fortified Polymer Cross breeds Composites: An Audit, pp 2959-2967.*
9. *Meltem Altin Karataş (2018) a survey on machinability of carbon fiber fortified polymer (CFRP) and glass fiber strengthened polymer (GFRP) composite materials, volume 4.*
10. *TP Sathishkumar, S Satheeshkumar and J Naveen (2014) Glass fiber-reinforced polymer composites – a review, Journal of Reinforced Plastics and Composites, Vol.33, 1258–1275.*
11. *Karthi, R. R., & Emmanual, L. Design and Analysis of Roller Shafts for Sugar Cane Mills by using FEA Technique With Different Parameters. International Journal of Mechanical and Production Engineering Research and Development, ISSN (ONLINE), 2249-8001.*
12. *Eken, S(2019) Free vibration analysis of composite aircraft wings modeled as thin-walled beams with NACA airfoil sections. Thin-Walled Structures, 139, 362–371.*
13. *Islam, M. E., Mahdi, T. H., Hosur, M. V., & Jeelani, S (2015)Characterization of Carbon Fiber Reinforced Epoxy Composites Modified with Nanoclay and Carbon Nanotubes. Procedural Engineering, 105, 821–828.*

14. *Bland P, Dear, J. (2010) Observations on the impact behavior of carbon-fibre reinforced polymers for the qualitative validation of models. Composites Part A: Applied Science and Manufacturing, 32(9), 1217–1227.*

15. *Vaghasia, B., & Rachchh, N. (2018). Evaluation of Physical and Mechanical Properties of Woven Bamboo Glass Polyester Hybrid Composite Material. Materials Today: Proceedings, 5(2), 7930–7936.*

16. *Katunin, A., Dragan, K., & Dziendzikowski, M. Damage (2015) Identification in aircraft composite structures: A case study using various non-destructive testing techniques. Composite Structures, 127, 1–9.*

17. *Ali, A. A. M., Negm, A., Bady, M., & Ibrahim, M. G. E. (2014). Towards an integrated tool to estimate carbon emissions from life cycle assessment of building materials in Egypt. International Journal of Research in Engineering and Technology, 2(3), 81-92.*

18. *Safri, S. N. A., Sultan, M. T. H., Jawed, M., & Jayakrishna, K. (2018) Impact behavior of hybrid composites for structural applications: A review. Composites Part B: Engineering,133, 112–121.*

19. *Bonacci J. F. and Maalej M.,(2001) Behavioral trends of RC beams strengthened with externally bonded FRP. Journal of composites for construction, Vol. 5.*

20. *L. Schadler, S. Giannaris, P. Ajayan (1998) Load transfer in carbon nanotube epoxy composites Appl. Phys. Lett., 73.*

21. *Sun, J., Li, H., Han, L., & Song, Q (2019) Enhancing both strength and toughness of carbon/carbon composites by heat-treated interface modification. Journal of Materials Science & Technology.*

22. *Alkahtany, L. A. Space Design for Hyperactivity and Distracted Attention (Methodology of Sustainable Materials Use).*

23. *Naresh, K., Shankar, K., Velmurugan, R., & Gupta, N. K. (2018). Statistical analysis of the tensile strength of GFRP, CFRP and hybrid composites. Thin-Walled Structures, 126, 150–161.*